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(54) IMPROVEMENTS IN BLOWERS FOR CONVEYING AN AIR/FIBRE MIXTURE

(71) We, TEMAFA, TEXTILMASCHINENFABRIC MEISSENER, MORGER & CO. GMBH. a German Company, of An der Zinkhutte 8, 5070 Bergisch Gladbach, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a flower for conveying an air/fibre mixture based on the principle of a centrifugal fan.

Fans having straight moving blades or curved blades are mounted on a flat rotor plate for the pneumatic conveyance of fibrous materials. For example, in Mode, "Ventilatoranlagen", 4th edition, page 82, an open impeller for the pneumatic conveyance of solid materials is proposed having a flat plate wheel, and in Eck, "Ventilatoren", 8th edition, page 479, an impeller which likewise has a flat plate wheel is proposed.

Blowers provided with rotors of this type display considerable disadvantages in the conveyance of the fibres, as a result of the high noise level produced due to the turbulent flow, the short service lives of the blades resulting from the high impact stress exerted on the blades, particularly by the fibrous bands which are fed in, the low fibre content of the in-drawn fibre-laden air and the high energy consumption resulting from the reduction in the efficiency owing to the disadvantageous conveyance of the fibres.

This has its origin in the unfavourable flow guidance of the fibre/air mixture. Especially when the bulk weights are high the fibre has a speed relative to the in-drawn air and thus does not follow directly the flow paths of the air. It is partially accelerated to the speed, particularly to the peripheral speed component, of the flowing air, only upon impact against the blades. Straight blades are thereby subjected to high impact loading, which frequently causes the blades to bend. In the case of curved blades and a flat plate wheel, the deflection of the fibres from the axial oncoming flow into the blower impeller for the radial acceleration towards the periphery of the impeller is again not effected without a movement relative to the in-drawn air, so that disadvantageous flow guidance in the impeller causes high material loading at the point where the fibres strike the impeller wheel plate, both for the fibres and for the impeller wheel plate. In addition, a high degree of erosion is produced at these points when dirt-carrying wool fibres are used, as a result of the entrained solid material or particles of sand.

In order to reduce these disadvantages at least partially, it is also frequently proposed that the blade be constructed such that it is small in height. However, this results in a limiting of the conveying capacity of the blower at the prescribed impeller wheel diameters and thus conflicts with the construction of pneumatic high power systems for the conveyance of fibres.

It has now been discovered that the construction of the impeller wheel plate in accordance with the flow of the fibre/air two-material mixture during deflection of the axial oncoming flow into the radial impeller wheel flow, and the way in which the blades are constructed so as to curve backwards against the direction of rotation in accordance with the acceleration of the two-material mixture, air/fibre, in a radial and peripheral direction, yields a three-dimensional impeller wheel, which substantially eliminates the above-discussed disadvantages of other impeller wheel plates for the pneumatic conveyance of fibres.

Thus the invention provides a blower for

the pneumatic conveyance of a fibrous material or fibre-containing material, comprising an impeller rotatable in a housing, said impeller comprising a rotor plate and curved blades attached to one side thereof, in which the rotor plate is curved in cross section to define an outer peripheral portion, a central portion which is axially inwardly offset relative to the peripheral portion, an oblique medial portion which is inclined at an angle of 40° to 60° to the rotary axis, a curved inner transitional zone which joins the central portion to the oblique portion and whose radius of curvature is 0.05 to 0.2 times the diameter of the impeller, and a curved outer transitional zone which joins the oblique portion to the peripheral portion and whose radius of curvature is 0.2 to 0.6 times the diameter of the impeller, and in which the blades are mounted radially outside said central portion of the rotor plate and each has an inclined inner leading edge which is inclined at an angle of at least 40° to the rotary axis, a free edge which is remote from the rotor plate and which extends transversely to the rotary axis and an outer trailing edge which is substantially parallel to the rotary axis.

A construction of this type is possible by constructing both the plate and the blades as pressed members and by interconnecting these members by means of short weld seams. The incline of the leading edges of the blades is of particular importance, since steep leading edges inhibit the fibre flow and lead to blockages. The limiting value for the incline of the leading edges of the blades is 40° with respect to the rotary axis, i.e. where possible the incline of the leading edges should be even greater.

The invention is further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is an elevation of a fan impeller, and

Fig. 2 is a section on the line II-II of Fig. 1.

Referring to the drawings, an impeller for a blower has a hub 1 to which an axially inwardly offset central portion 9 of a rotor plate 2 is attached, e.g. by welding. An outer transitional zone 3 of the plate 2 joins an oblique portion 11 of the plate 2 to an outer peripheral edge portion 4 of the plate 2. This zone 3 serves mainly to change the axial component of flow into a radial component of flow. The outer periperal edge portion 4 of the plate 2 is spaced a short distance from the blower housing (not shown). The roots 5 of the blades 6 are preferably located at the beginning of a curved inner transitional zone 12 joining the oblique portion 11 of the plate 2 to its central portion 9, i.e. at the outside of the flat central portion 9 of the plate 2. The leading edge 7 of the blade rises obliquely from the plate 2 at a certain angle β which is at least 40° with respect to the rotary axis and is preferably between 40° and 70°. The free edge 8 of the blade remote from the plate 2 extends transversely to the rotary axis and is preferably straight. The outer trailing edge 13 of the blade 6 is substantially parallel to the rotary axis.

The flow of the fibre/air mixture which enters the fan housing in the direction of the hub 1, is accelerated in two directions, the radial and the peripheral direction. The axial flow component is thereby retarded to the value zero. The radial acceleration commencing after entry into the housing but prior to reaching the hub 1 also deflects the fibres to such an extent that the fibres barely strike against the hub 1 but mainly strike tangentially against the oblique portion 11 and the curved transitional zones 1 2 and 3 of the rotor plate. The acceleration of the fibres in a peripheral direction does not cause the fibres to strike the blades either, but causes the fibres to flow over the convexly curved outer sides of the blades.

The construction of the rotor plate is such that the radius of curvature of the transitional zone 12 between the portion 9 and the oblique portion 11 is 0.05 to 0.2 times the diameter of the impeller, the axial offset between the central portion 9 and the outer peripheral edge portion 4 of the rotor plate is 1/5 to 1/10 times the diameter of the impeller, the angle α of slope of the oblique medial portion 11 is from 40° to 60° to the rotary axis and the radius of the outer transitional zone 3 is 0.2 to 0.6 times the impeller diameter.

The blades 6 attached to the plate 2 are curved back convexly facing the direction of rotation to initiate the curve according to flow technology of a fibrous ball of average density. The blade is thus curved slightly more than the blade according to the constructional principles which are, for example, given in Mode, "Ventilatoranlagen", 4th edition, page 60, for pure air. The free edge 8 of the blade extending transversely to the rotary axis may thus be perpendicular to or inclined to the rotary axis, although the perpendicular arrangement is advantageous.

The fan housing (not shown) around the impeller may be of standard construction, such as is described in Mode, "Ventilatoranlagen", 4th edition, page 72. In such a construction, the free edges 8 of the blades are parallel to the adjacent side wall of the housing.

For the impeller of the blower according to the invention to be effective, an axial

clearance 0.05 to 0.2 times the diameter of the impeller should remain between the free edges 8 of the blades and the housing, the overall axial dimension of the blades, as measured along their outer trailing edges 13, being 0.1 to 0.5 times the diameter of the impeller.

Thus blockages in the blower caused by fibrous balls are substantially eliminated.

The blower having the impeller shown in the drawings has a steep characteristic curve as compared with other blowers. This affects the conveyance in the adjoining pipe line inasmuch as an alteration in the pipe line characteristic when the fibre loading changes leads to a strongly variable pressure build-up in the blower. This has a favourable effect, particularly when blockages commence, in that the blower clears the pipe line by blowing by means of a great increase in pressure. The capacity which the blower has for accepting fibres, which capacity is substantially greater than that of other blowers, means that altogether a smaller amount of air is required for the transport of a certain amount of fibre and thus less outgoing air, which is charged with dust particles, may be produced during conveyance. The reduction in the amount of dust particles in the air contributes to the improvement in working conditions. The smaller amount of air also makes it possible for pipe lines of smaller diameter to be used to convey the same amount of fibre, and this leads to a considerable saving with respect to material and space in the conveying system.

The optimum flow guidance of the fibre/air mixture in the impeller leads on the one hand to a considerable reduction in noise as a result of the lower relative speeds and vorticities, and on the other hand the same effect is expressed in the considerable reduction in power consumption by the blower, i.e. increased efficiency of conveyance of the fibre/air mixture in the blower. These improvements also lead to considerable alterations with respect to the handling of the fibre. The shortening of the staple length by the blower is reduced.

The geometry of an impeller for a blower according to one embodiment of the invention will now be described.

An impeller having a diameter of 700 mm has seven blades. Each blade 6 has a breadth of 300 mm as measured along its curved surface and a maximum axial dimension of 200 mm. The straight free edge 8 of the blade is 125 mm long. The inner diameter up to the roots 5 of the blades is 240 mm, the blades substantially reaching their maximum axial dimension at a diameter of 525 mm. The centre portion 9 of the plate 2 is axially inwardly offset by 108 mm from the outer edge 4 of the plate. The radius of the inner transitional zone 12 extending from the portion 9 to the oblique medial portion 11 is 65 mm. The radius of the outer transitional zone 3 is 265 mm. On both the suction side and the pressure side the housing has pipe connections (not shown) with a diameter of 300 mm. The internal axial dimension of the housing is 300 mm, an axial clearance of 20 mm being provided on the plate side and a clearance of 70 mm being provided on the blade side. The thickness of the metal of the rotor plate is 5 mm. The conveying capacity of the blower is 3 tonne of fibres per hour.

The blower according to the invention displays the most advantageous characteristics during the conveyance of fibres and fibre-containing materials.

WHAT WE CLAIM IS:—

1. A rotary blower for the pneumatic conveyance of a fibrous material or fibre-containing material, comprising an impeller rotatable in a housing, said impeller comprising a rotor plate and curved blades attached to one side thereof, in which the rotor plate is curved in cross section to define an outer peripheral portion, a central portion which is axially inwardly offset relative to the peripheral portion, an oblique medial portion which is inclined at an angle of 40° to 60° to the rotary axis, a curved inner transitional zone which joins the central portion to the oblique portion and whose radius of curvature is 0.05 to 0.2 times the diameter of the impeller, and a curved outer transitional zone which joins the oblique portion to the peripheral portion and whose radius of curvature is 0.2 to 0.6 times the diameter of the impeller, and in which the blades are mounted radially outside said central portion of the rotor plate and each has an inclined inner leading edge which is inclined at an angle of at least 40° to the rotary axis, a free edge which is remote from the rotor plate and which extends transversely to the rotary axis and an outer trailing edge which is substantially parallel to the rotary axis.

2. A blower as claimed in claim 1, in which the central portion of the rotor plate is axially inwardly offset relative to its peripheral portion by 1/5 to 1/10 times the diameter of the impeller wheel.

3. A blower as claimed in claim 1 or 2 in which the leading edges of the blades are inclined at an angle of 40 to 70° with respect to the rotary axis.

4. A blower as claimed in any of claims 1 to 3 in which the axial length of each blade at the outer edge of the im-

peller wheel is 0.1 to 0.5 times the diameter of the impeller wheel.

5. A blower as claimed in any of claims 1 to 4 in which the free edges of the blades extend parallel to the side wall of the housing.

6. A blower as claimed in any of claims 1 to 5 in which an axial clearance of 0.05 to 0.2 times the diameter of the impeller is provided between the free edges of the blades and the adjacent housing side wall.

7. A blower constructed substantially as herein described with reference to and as illustrated in the accompanying drawings.

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1 514 756 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG. 1

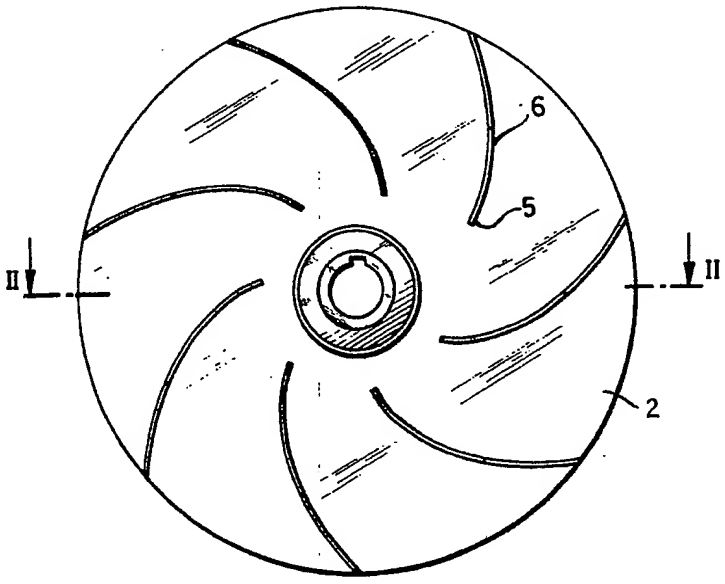

FIG. 2